PERCIVALL POTT'S ROLE IN THE HISTORY OF SURGERY AND FRACTURE THERAPY

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HISTORICAL BACKGROUND

In the consideration of fractures up to the time of Pott, we must always keep the fact in mind that all of the diagnostics of the times, including those of Pott, were based on clinical findings and until the time of Wilhelm Conrad Roentgen (1845-1923) no truly accurate means of diagnostic or therapeutic control was available.

There is evidence that some of the cave men of the Neolithic and of the New Stone Ages knew how to treat fractures and wounds. They were well aware of the value of a stick or similar object which could be used as a splint and were capable of performing such complicated operations as skull trephinations. More often than not, healing was allowed to be spontaneous and the result, although cosmetically lacking, was functionally adequate.

Chinese Surgery was advanced by Yu Fu who was a surgeon during the reign of Huang Ti, who was known as "The Yellow Emperor" (2698-2598 B.C.), and he was able to do many surgical procedures such as ligating blood vessels, cleaning the bowels, exposing the brain and the cord, and suturing tendons.

During the Tsin dynasty, operations on hare-lips were performed and in the Chou dynasty, Pien Ch'iao performed open heart operations as well as stomach operations. In order to provide eunuchs to care for the imperial harems, the operation of castration was performed. Hemorrhage was controlled by manual compression with alum bandages and a catheter put into the urethral stump. The amputated parts were preserved and cared for until the death of the eunuch and then buried with him in order that he be able to meet his ancestors, which according to their beliefs was impossible if the person was buried in a mutilated state.

The ancient Hindu surgeons were masters of plastic surgery, in particular in the field of Rhinoplasty. They were never at a loss for patients on whom their Rhinoplasty operation was indicated. In this culture, the punishment for adultery was amputation of the nose. The ridiculous feature about this practice is that there were surgeons who performed this amputation and others who performed reconstructive operations. Sushruta, who is consi-

dered to be the father of Hindu surgery (about 600 B.C.), in his work, "Samhita" stated that bandaging is an art which should be learned thoroughly. He recommended that students practice on dolls and classified about fourteen types of bandaging materials which are derived from plants and animals.

The idea of malpractice suits is not original with our present civilization, but stems from older eras in history. Some of the more famous legal codes were the "Visigothic Code" and the "Code of Hamurabi"(1728-1686 B.C.). These codes dictated that if a physician injure or kill a slave, he must replace him with one of equal value. They also believed in letting the physician suffer at the mercies of a freeman who happened to lose a relative who was under the care of that physician. Other laws concerning the physician of the royal court were even more strict. If one of the royal family died while under the charge of the physician, the corresponding member of the physician's family was put to death. Thus, if the princess or prince died, the physician's son or daughter was put to death. If the queen died, the physician's wife was executed, and if the king died, so did the physician. Under other less important circumstances, the physician was merely forced to pay a fine.

Some of the ancient Indian tribes of North America utilized splints made of animal hides which could be adjusted as the process of healing progressed. In cases of open fractures, they created a kind of window in the leather splint which allowed the wound to drain itself.

Some of the Indians of Australia in ancient times used clay soaked bandages in the same manner as the plaster of paris cast is used today. They also used wooden splints.

Among ancient peoples, some of the following operations were performed as a part of a ritual: trephination, amputations, and circumcisions. Circumcision did not originate with the Jews, as most people believe, but with more ancient peoples and was even in vogue in the ancient Egyptian civilizations.

As far as methods for dressing wounds and fixing fractures are concerned,

on can easily look to the ancient Egyptians who were masters in this field even though most of their work was performed post mortem. The purposes which they assigned to the bandages they applied to the living were: to keep the wound in place, to keep the injured part at rest, and to keep the medications (oil, meat, and herbs) applied to the skin. The Edwin Smith Papyrus, a surgical compendium from the year 1600 B.C., contains many descriptions of treatment of fractures and the art of bandaging. It recommends treatment with fresh meat at the beginning of the first day, followed by grease, honey, and lint until recovery is accomplished. Most of the "grease" used consisted of animal fats. After discussing the diagnosis in this document, the author classifies his prognosis into those ailments which are to be treated, those which will not be treated, and those ailments with which he will contend. For a fractured humerus, he recommends that one should lie the patient on his back with a support beneath his shoulder blades, support his arm with linen splints, and bind it with an unknown material known as a "ymrw". Later, it should be treated with honey.

Hippocrates (460 B.C.) differentiated between open and closed fractures and declared that the former possessed a poorer prognosis than the latter. He initiated the therapy of extension and counterextension and took the necessary precautions to be sure that the limb was placed at rest. He maintained that if a piece of bone or cartilage were broken off it would not be replaced. He stated that skull fractures tend to follow the sutures, and that one means of diagnosing a skull fracture is to ask the patient to chew on something and to note whether he hears a crepitus. He also described the sign of the collection of fluid beneath the skin overlying a fracture. Open fractures at this time were treated with external medications as alaun and copper salts which were used as drying agents. Hippocrates favored the external use of wine and used plaster bandages to secure the fracture and the applications.

130 A.D. was the year in which the great Galen was born at Pergamum in Asia Minor. His name is famous in the history of medicine and, as not often the case, he enjoyed his renown during his lifetime. He treated some of the highest citizens of Rome and dissected apes for the study of anatomy.

He was also physician to the Gladiators and was thus able to obtain a large number of cases concerned with varied traumata. He resected ribs as well as the sternum and wrote about exposing the heart through removal of the sternum. He treated clavicle and acromion fractures with oil and water bandages and used wool at vital places to prevent decubitus.

In the 10th century, Arabian physicians (Rhazes, Ali ben Abbas, Avicenna, Ibn al Quiff, and Abulkasin) recognized the signs of fractures such as the associated pain, the crepitation, the deformation, the alterations in the skin contour, and the palpation of the broken ends of the bones.

In the 14th century, the famous French surgeon, Guy de Chauliac wrote his work, "La Grande Chirurgie" after his studies at Montpellier and this work was considered as the basis of surgical practice not only in France, but in many other countries for the next three centuries. He discussed fractures (Fractura simplex et composita) and luxations. For the positioning of the leg, he recommended a cunabulum or a suspensorium or a palea. He also discussed callus formation and the removal of bone fragments.

Felix Wirz who lived at the beginning of the 16th century also preferred the conservative treatment, but he did treat fractures with splints and plaster casts.

In 1500 in Germany, Hieronymus Brunschwig and Hans Gersdorff differentiated between fractures and longitudinal fissures. They treated fractures of the ribs with wooden splints and splints made of horn, iron, and leather.

During the middle ages in Europe, surgery became a "step-child" of medicine, and was considered more of quackery than of science or art. This idea was not altogether false when one considers the vagabond surgeons who performed operations for stone, cataract, and hernia. These "merchants" could not afford to remain in one place for too long a time after they had performed their special operations for fear of punishment after the almost certain complications set in. They were therefore compelled to wander and were looked down upon by members of the other occupational classes. They became associated with the lowest occupational groups as barbers and thieves. These surgeons also treated fractures, wounds,

and dislocations. They possessed a universal misconception at this time that suppuration was an essential part of the healing process. They completely abandoned the idea of the Greeks of ligating blood vessels and preferred to check bleeding with hot irons and boiling oil. Because of their belief in suppuration, they employed salves of horrid composition and unbelievable filth to initiate this process.

From the 9th to the 12th centuries, Medical Schools began to be established in Europe, the first being organized at Salerno. They at last established some principles by which physicians could be taught their art and examinations could be prescribed to determine their competence.

At the University of Bologna, surgery was taught with industry and seriousness and was not considered an inferior handicraft. Hugh of Lucca and Theodoric of Cervia, father and son respectively, taught here. Hugh of Lucca worked during the Crusades in Syria and Egypt and died in 1252. His son, a member of the Church of the Dominican Order and the Bishop of Cervia, often quoted his father's works and made many original contributions. He did not believe that suppuration was necessary for the healing of wounds and he did away with the salves mentioned above. He also used a "Soporific Sponge" which was able to induce sleep in surgical patients.

The main disadvantage which had to be overcome was the lack of anatomical and pathological studies through dissection. In 1446 at Padua, a special anatomical theater was constructed. The material was derived mainly from executed prisoners.

Slowly, anatomy began to flourish and students of the subject realized the value of illustrations for their work. Therefore, as could be expected, the first anatomists included artists such as Donatello, Michelangelo, Raphael, and Leonardo da Vinci.

The man credited with the founding of anatomy as a science is Andreas Vesalius (1514-1564) who was a native of Brussels and taught at Bologna and Padua. He received his medical education at Paris. His work, De Humani Corporis Fabrica, was printed at Basel, Switzerland, by Johannes Oporinus in 1543 after many other printers in Europe refused to publish

the controversial work with illustrations by Jan Stefan van Kalkar.

Ambroise Paré (1510-1590) was a great military surgeon. He did away with the boiling oil used in treating gunshot wounds and reintroduced the procedure of ligating blood vessels. He used this method of ligation rather than the cautery which was common in amputations. He was a prolific writer and wrote in French rather than in Latin and became an authority in military surgery.

During the 14th century in England, many trades became organized into Guilds. Because the barbers and the surgeons were from tradition in the same economic and social class, they eventually became organized into one common Guild. This was the result of a compromise to prevent the barbers from overstepping their bounds and invading the territory of the surgeons. They were later called, "Masters or Governers of the Mystery and Commonality of the Barbers and Surgeons of London". This name became shortened to, "Barbers' and Surgeons' Company". This Guild lasted until 1745 and included among its members, Percivall Pott. In 1800 the "Company of Surgeons" became "The Royal College of Surgeons of London" under the charter granted by George III. In 1843 Queen Victoria granted a new charter and the name became, "The Royal College of Surgeons of England".

One of the most ingenious surgeons on the Continent who lived in Berne, Switzerland, was Fabricius Hildanus (1560-1634). This man invented many surgical instruments including a method of amputating with a red hot knife, an aural speculum, splints and a forceps for the removal of foreign bodies. His wife treated gynecological patients and fractures although she was not a surgeon.

In 1628, William Harvey, a predecessor of Pott's at St. Bartholomew's, made the discovery of the circulation of the blood in the human body and was able to revolutionize the entire field of medicine and surgery. He opened the road for the technique of blood transfusion and intravenous administration of medications.

William Cheselden (1688-1752), also of England, was able to reduce the mortality rate in the operation for stone of the bladder from 50% to less than 10% and his speed in performing this operation was phenomenal.

While other surgeons needed about one hour's time to complete the operation, Cheselden was able to do it in one minute with a record time of 54 seconds! I think his record still stands.

Another surgeon deserving of mention was a student of Pott's. His name was John Hunter (1728-1793) and he became even more famous than his teacher. He spent four years as an army surgeon and also studied under Cheselden. He initiated many studies into comparative anatomy and physiology and possessed quite an impressive collection of animals which be studied both in the living and in the dead state.

THE LIFE OF POTT: (1714-1788)

Percivall Pott was born in London on the 6th of January in 1713 or 1714. His father was a scrivener and they lived on Threadneedle Street. His mother had previously been married to the son of Sir James Houblon, but his unexpected death in the army ended the short-lived marriage. When her second husband, Percivall Pott's father, died, the family, consisting of Percivall, his mother, and his half-sister, was left destitute. They survived only through the aid of a distant relative, Dr. Wilcox, bishop of Rochester, and it was also through his aid that Percivall attended a private school at Darne or Darenth in Kent. The boy soon showed an eager interest in surgery and from August 1st 1729, he served seven years with Edward Nourse as an apprentice. Nourse was an assistant surgeon at St. Bartholomew's Hospital, and he gave private lessons in anatomy. Percivall Pott became expert in dissection and preparation of the various specimens for display during these lectures. Finally, when Pott became self-sufficient, he rented a house in Fenchurch Street for himself and his family. He did this only after he had received his diploma and became a full member of the Barber-Surgeons' Company. There he was a member until the Company dissolved in 1745 at which time Pott joined the newly formed Corporation of Surgeons.

On March 14th 1744, Pott became the assistant-surgeon in St. Bartholomew's, and five years later, he became a full surgeon. During the time of his position as chief surgeon at St. Bartholomew's, he tried to modernize the profession and to improve it so that the treatments the patients received were more humane and less painful. He did away with a great many of the old complicated instruments which resembled a torture chamber of horrors rather than a hospital surgeon's instruments and reduced the use of the cautery to a minimum.

In 1756, Pott was the victim of a cruel accident which was the turning point of his life. He was thrown from a horse while riding in Kent Street, Southwark, and sustained an open fracture of the leg: one of the most dangerous injuries which he could have received. Realizing full well the precariousness of his situation, Pott lay on the ground (it was the middle of January) and refused to be moved until adequate preparations for his re-

moval to the hospital could be furnished. He was brought to his home where several surgeons examined him and recommended amputation of his leg. Not content with their decision, Pott summoned his teacher, Mr. Nourse, who came and after his examination, declared that there was a possibility that the leg be saved. It was during his long convalescence after this fracture that Pott did most of his writing. In 1764, Pott was elected as a fellow of the Royal Society.

Pott was very attached to his mother, and it was because of this attachment that he married late in life. In 1746, he married Sarah Cruttenden and she presented him with a large family consisting of five sons and four daughters.

One of the legacies of Pott lies in his best student, John Hunter, who actually became more famous than his teacher and succeeded Pott in the court of assistants of the Surgeons' Company after Pott's death.

Pott died on December 22, 1788, of pneumonia at his home in Hanover Square and was buried on January 7, 1789, in the chancel of St. Mary's Aldermary, in Queen Victoria Street.

PERCIVALL POTT'S IDEAS ON FRACTURES

A. Fractures of the Skull

In his "Observations on the nature and consequences of those Injuries to which the Head is liable From External Violence" Pott discusses the method of treating lacerations of the scalp. Whereas some practitioners of the time recommended that all of the torn tissue be removed and others that as much of the scalp be spared removal as possible; Pott recognized that there could be no hard and fast rule of treatment. He admits that there are times when some of the skin cannot be saved and must be removed The danger removing the lacerated portions according to him are a delayed healing; enlarging the wound, which would be synonymous with enlarging the complications of the original wound (i.e. bleeding and inflammation), as well as additional discomfort to the patient and the possibility of a poor cosmetic outcome. On the other hand, he also states that the presence of injured tissue may conceal a deeper injury perhaps even a cranial fracture. He concludes that each laceration should be treated individually and that where the tissue can be preserved, it should be sewn together with several stitches.

He describes his "puffy tumor" as follows:

"If there be neither fissure nor fracture of the skull, nor extravasation, nor commotion underneath it, and the scalp be neither considerably bruised, nor wounded, the mischief is seldom discovered or attended to for some few days. The first attack is generally by pain in the part which received the blow. This pain, though beginning in that point, is soon extended all over the head, and is attended with a languor, or dijection of strength and spirits, which are soon followed by a nausea, and inclination to vomit, a vertigo or giddiness, a quick and hard pulse, and an incapacity of sleeping, at least quietly. A day or two after this attack, if no means preventative of inflammation are used, the part stricken generally swells, and becomes puffy, and tender, but not painful; neither does the tumor rise to any considerable height, or spread to any great extent: if this tumid part of the scalp be now divided, the pericranium will be found of a darkish hue, and either quite detached, or very easy separable from the skull, between which and it will be found a small quantity of a dark-coloured ichor". [1]

He then goes on to describe how the symptoms of this malady increase in intensity ultimately with dural involvement. Quite apparently, the anatomy of the Dura Mater is known to Pott and he spends some time discussing it and laying aside some of the earlier beliefs, particularly those of Hippocrates, Paulus Egineta, and Rhazes who believed that the dura was only

1. Pott: "The Chirurgical Works of Percivall Pott"; p. 38-39

bound tightly to the skull at the site of the sutures, and that spaces were provided as receptacles for inflammatory and extravasated fluid. Pott describes the dura as being fixed to the entire inner surface of the cranium and that the only time it does separate from it is due to the presence of pus and/or blood.

He discusses the therapy, and although he is convinced of the value of phlebotomy, he recommends that it only be performed when the injury is sufficiently severe as to warrent it. He advises that an unnecessary phlebotomy will only serve to make the patient more anxious and apprehensive.

Trephination of the skull he conceeds is a difficult procedure and it's value still controversial. He favors trephination when there is a definite indication for it, such as in the case of inflammation of the meninges (the dura) and by penetrating wounds extending into the cranial cavity as for example gunshot wounds.

Pott's classification of fractures of the skull, he admits, does not differ considerably from the ideas of his predecessors. He claims that the difference between a fracture and a fissure is merely quantitative and is measurable as the space between the separated bones. He also differentiates between fractures which are depressed (that is to say that the bone parts which have separated, lie in different planes to each other) and those which are not depressed (those which lie in the same plane). The differential diagnosis between these entities, he considers as basic.

As far as the symptoms of cranial fractures are concerned, Pott considers the symptoms of nausea, vomiting, accelleration of pulse, etc., as not being signs of the fracture per se as was assumed by Celsus, but as being signs of injury to the brain itself, particularly to the tentorium.

Returning to the subject and the controversy of trephination, Pott considers that it is always necessary in the case of depressed fractures and indicated for early use in the case of the undepressed fractures more for prophylactic purposes (i.e. for preventing extravasations within the meninges in case of inflammation) than for therapeutic. ones. His indications and his reasons for trephning are:

"The reasons for trepanning in these cases are, first, the immediate relief of present symptoms arising from pressure of extravasated fluid; or second, the discharge of matter formed between the skull and dura mater, in consequence of inflammation; or third, the prevention of such mischief, as experience has shewn may most probably be expected from such kind of violence offered to the last-mentioned membrane". [1].

Fresh fractures to the skull should be trephined with the modern and vastly simplified and improved instruments of Pott's era. The procedure should be done for prophylaxis and therapy of inflammation to the meninges and should be accompanied by other supportive measures such as phlebotomy and enemas. Wherever necessary, small bone fragments should be removed from the wound. The possibility of "contra-fissure", that is, a fracture of the skull on the side opposite the surface of the skull which was acted upon by the external force, should always be kept in minol. He allows that such a fracture is conceivable and that it should be treated in the same manner which he recommended for the other equivalent fractures. The prognosis for multiple cranial fractures is very poor and Pott declares that he has not seen one survival of such a fracture.

The contention made by Pott that the temporal bone cannot be removed by surgeons is based on his knowledge that the aponeurosis of the musculus temporalis covers it and therefore must be severed before the bone is removed which is a complicated procedure. Also, the proximity of the temporal artery, although it may be ligated, presents an ever present hazard as does the danger of lock jaw. Percivall Pott realized that although lock jaw produces a spasm of the temporal muscle among others, he maintained that the condition could also result from a distant focus, in other words, he recognized the fact that lock jaw was not merely a localized process, but a generalised condition which was eventually fatal.

The section is concluded with a brief discussion of head bandages. As is the case with surgical instruments, Pott says that the simpler the bandage, the better it is both for the physician and for the patient. He is of the opinion that a loose night cap is by far better and more comfortable to the patient than the most elaborate bandage.

1. Ibid; p. 138

Pott was aware of the fact that concussion (commotio) and contusion of the brain are separate pathological entities and he tries also to separate them. In this, I feel he was unsuccessful because his differentiation is only in degree and the signs and symptoms are so similar that his attempt to describe their differences is at best vague. His main contribution on this subject is his discussions of the anatomy and topography of the skull, in particular that of the dura mater.

B. Fractures of the Extremities

The bones, to Pott, are static and passive objects which only come into play when acted upon by some external force which is provided by the muscles. Were it not for the muscles, the bones would not move on their own, and the power of the muscles exerted on the bones is caused by muscle contraction. As soon as the continuity of the bone is incomplete as in the case of a fracture, the muscles contract and instead of movement, there occurs a shortening of the extremity involved. This is regarded by Pott as a diagnostic criterium.

Many of the practitioners of Pott's time, advanced the idea of extension and fixation of the fracture. Pott takes issue with this viewpoint. He declares that it is the extension which causes the patient the greatest amount of pain and discomfort, because in doing so, the contracted muscles must be stretched beyond their normal limits causing a painful stimulus and unnatural lengthening of an abnormally short extremity. To illustrate this point, he observes that a patient who has fractured his humerus spontaneously assumes a position with his affected arm flexed at the elbow so as to avoid unnecessary discomfort and pain. Similarly, a patient who has sustained a fracture of the femur will lie with his leg flexed at the knee.

Because the extremity is extended to an abnormal length, the distance between the two ends of the fractured bone is also greater and thus is the time it takes for the callus to bridge this gap proportionally longer than it otherwise need be.

Extending a fractured extremity, according to Pott, is also a tedious procedure; it calls for the use of a great many complicated instruments which he regards as not advantageous because his entire philosophy of surgery is based on the premise that the art should become simpler and less complicated with time.

Concering the use of external medications he cites the varied remedies used by workers in the field. They make use of such things as: adhesive, which they refer to as "roborant plaster", a cere-cloth, spirits of wine and oil, vinegar, whites of eggs, "spirit. Mindereri", solution of crude sal ammoniac in vinegar and water, among those most often employed. As for his own preference he states:

"At St. Bartholomew's Hospital, we use a cerate made by a solution of lytharge in vinegar, which with soap, oil, and wax, is afterward formed into such consistence as just to admit being spread without warming". 1.

1. Ibid; p. 396

Once the medicine is applied and the bandage in place, the fractured limb should not be moved. It is true that the bandage ought to be replaced from time to time as the surgeon sees fit, but in doing so, he should disturb the resting limb as little as possible until consolidation of the fracture has taken place. Some of the surgeons of the time preferred to use a device known as a "roller" but Pott dislikes the use of this apparatus because it generally provokes movement of the extremity. Dressing a fracture is to Pott one of the most tedious tasks in all of surgery and he speaks about the "tired state of the surgeon" after the application of such a bandage.

Concerning the bandage, it is immaterial and more a matter of personal taste and discretion whether one begins proximal on the extremity and works to the distal end or vice versa.

Most practitioners were of the opinion that swelling of the bandaged limb was a good sign and signified the coming healing and callus formation. Pott holds that this is merely a sign that the bandage is too tight. He disagrees with his contemporaries who suppose that a tight bandage prevents redundance of the callus, and to support his standpoint he discusses the physiology and the purpose of the callus.

The callus is formed from the "circulating juices" and serves to cement the disunited bones together in much the same fashion as a scar does in a skin lesion. In the case of transverse fractures, the juices circulate smoothly and are regularly laid down so that the callus formed is symmetrical and perfect. On the other hand, in the case of a fracture running obliquely, or otherwise irregularly, the juices cannot circulate freely and are laid down in irregular fashion corresponding to the irregularities of the fracture and thus the chances that the callus will become redundant increase significantly. Prevention of callus redundancy is the goal of the surgeon and it is his responsibility to see that the leg is properly bandaged and rested and that the patient is told not to move his limb. At St. Bartholomew's he used the eighteentailed bandage and the surgeons were instructed that fractures were to be kept immobile even during the changing of

the dressing. The fractured limb should rest comfortably on a pillow.

Percivall Pott discusses the use of splints, and on the whole seems to disfavor their use because of the uncertainty of what the proper length of such a splint should be and whether or not the splint can actually impede the tendency of a fracture to heal by being applied wrongly. The splint is called for, moreover, in those cases where it is advisable to prevent a joint from moving. In seeming contradiction to his favoring flexion over extension, he recommends the use of a long splint in the case of a fracture of the leg, for example, which will bridge the knee and thus prevent flexion of this joint.

Concerning fractures of the hand, Pott recommends splinting the hand in the position of function, that is with the arm at rest in a position between supination and pronation and with the fingers slightly bent. He also claims that the hand should be splinted and comfortably fixed to the chest in such a position that the thumb is cranial to the small finger.

Fractures of the femur should then be treated with flexion and an eighteen-tailed bandage and the leg be placed on a pillow. If the leg is not comfortable on the pillow, the pillow may be placed on the leg. Fractures of the tibia and the fibula should be treated in a similar manner, whereas fractures of the fibula alone are much more responsive to therapy because of the tendancy of the intact tibia to hold the form of the leg.

His original description of the mechanisms involved in bringing about the fracture, which now bears his name, and discussions concerning this condition are now presented:

"If the tibia and fibula be both broken, they are both generally displaced in such manner, that the inferior extremity, or that connected with the foot, is drawn under that part of the fractured bone which is connected with the knee; making by this means a deformed, unequal tumefaction in the fractured part, and rendering the broken limb shorter than it ought to be, or than its fellow. And this is generally the case, let the fracture be in what part of the leg it may" [1].

"This is the case, when, by leaping or jumping, the fibula breaks in the weak part already mentioned, that is within two or three inches of its lower extremity. When this happens, the inferior fractured end of the fibula falls inward toward the tibia, that extremity of the bone which forms the outer ancle is turned somewhat outward and upward, and the tibia having lost its support, and not being of itself capable of steadily preserving its true perpendicular bearing, is forced off from the astragalus inwards, by

1. Ibid; p. 435

which means the weak bursal, or common ligament of the joint, is violently stretched, if not torn, and the strong ones, which fasten the tibia to the astragalus and os calcis, are always lacerated; thus producing at the same time a perfect fracture and a partial dislocation, to which is sometimes added a wound in the integuments, made by the bone at the inner ancle. By this means, and indeed as a necessary consequence, all the tendons which pass behind or under, or are attached to the extremities of the tibia and fibula, or os calcis, have their natural direction and disposition so altered, that instead of performing their appointed actions, they all contribute to the distortion of the foot, and that by turning it outward and upward". [1]

This fracture, he admits, is often of the open variety and is therefore complicated by the damaged integument and tendons. The result of this complication is a fearful gangrene which jeopardizes the life of the patient. Early amputation of the involved extremity is usually recommended as a prophylactic measure although Pott claims that he has often seen cases of spontaneous recovery and does not concur with those who recommend early amputation. However, one cannot avoid the subsequent deformity to the extremity after the period of healing.

In the fixation of almost all fractures, the extremity should be flexed for best results. The only two fractures which do better in the extended position are fractures of the patella and of the elbow, i.e. olecranon process.

As far as the patella is concerned, Pott reasons that when the leg is extended, the muscles which are attached to the upper end of the broken bone are put into relaxation and thus a less painful recovery may be expected. Pott discussed the theory and which he regards as being obsolete other physicians held as truth, that when the leg is extended, the quantity of formed callus is increased to such an extent that a general stiffness of the knee joint results. He cites that in his experience, he has never witnessed such a case, and therefore concludes that extension, far from being harmful, is quite beneficial to the healing of a fractured patella. If the knee joint does actually become stiffened, the trouble is not located in the formation of the callus, but in the ligaments and tendons surounding the joint.

1. Ibid; p. 437

The next item which he discusses, is the phenomenon which he calls "the rising end of a broken bone". It was observed in the case, for example, of a fracture of the clavicle, that one of the ends of the bone was displaced in a positon "superior" to that of the other part of the bone. Many of the surgeons treated such a rising bone, by trying to replace the bone into its original position and fixing it there, thus hoping to create a union resulting in perfect resolution of the fracture. Pott takes issue with this practice saying that the others have misinterpreted this condition and that actually it is not the superior bone (the rising bone) which has been displaced, but the other bone, the inferior one. The therapy of replacing the superior based on this misinterpretation of the truth, Pott regards not only as nonsense, but as causing a great deal of pain to the patient, and in the end effect, it is a harmful procedure. He advises that the inferior bone, the bone which did not rise be the one to be replaced for proper therapy.

One of the first decisions with which a surgeon is faced when he encounters a compound fracture is that whether or not the involved limb will be able to be saved or whether the patient must suffer an amputation. Preservation of complicated limbs, usually leads to the death of the patient and therefore, the surgeon should not be moved by a false sense of pity or timidity, but should act promptly and courageously. There are times, when the limb might be saved, and these are the times when the physician must exercise prudence.

Once the decision is reached that the limb be spared, the next problem to be solved by the surgeon is that of reducing the fracture. More often than not, the broken bone will protrude through the skin, frequently with sharp edges and this will greatly hinder reduction, and may present an indication for amputation.

Amputation, however, can be overcome with the technique for reduction which Pott advocates. One should open the wound carefully, causing as little pain and discomfort to the patient as possible. With this enlarged wound, the broken bits of bone, and foreign particles may be removed and the ends of the bones joined with more facility. He also advises probing and cleaning of the wound, but with gentleness so as not to cause unnecessary pain. Above all, all forceful attempts at reduction must be

avoided. After the fracture is reduced and the wound cleaned, reposition should be effected as in the case of the closed fracture with the extremity in a flexed position. Then, at last, the dressing should be applied.

He discusses the choice of splints and bandages in the next part of his discourse, but adds nothing new to the subject other than what he has already mentioned in the section of closed fractures. He summarizes his indications for amputation at the close of the chapter on fractures as follows:

"From what has been said, it will appear, that there are three points of time, or three stages of a bad compound fracture, in which amputation of the limb may be necessary and right; and these three points of time are so limited, that a good deal of the hazard or safety of the operation depends on the observance or non-observance of them".

"The first is immediately after the accident, before inflammation has taken possession of the parts. If this opportunity be neglected or not embraced, the consequence is either a gangrene or a large suppuration, with formation and lodgement of matter. If the former of these be the case, the operation ought never to be thought of, till there is a perfect and absolute separation of the mortified parts. If the latter, no man can possibly propose the removal of a limb, until it be found by sufficient trial, that there is no prospect of obtaining a cure without, and that by not performing the operation, the patient's strength and life will be exhausted by the discharge. When this becomes the hazard, the sooner amputation is performed, the better. In the first instance, the operation ought to take place before inflammatory mischief is incurred; in the second, we are to wait for a kind of crisis of such inflammation; in the third, the proportional strength and state of the patient, compared with the discharge and state of the fracture, must form our determination". 1.

On the subject of dislocations, Pott says that the therapy prevailing at the time is ancient, and the practitioners are more content to copy the therapy of the older eras of medical history, or to copy from each other without trying to find a better way of treatment. Once again, he lashes out against the use of complicated machines in treatment. His idea of simplification of the art of surgery being synonymous with progress in the field is totally incompatable with the idea of replacing dislocated joints with machines more adapted to the task of pulling joints apart rather than putting them back together again. He tends to value a thorough knowledge of anatomy more than a thorough knowledge of mechanics.

1. Ibid; p. 483-484

He argues that much of the physical effort on the part of the operator is lost in the reposition of a dislocated joint because of other joints interposed between the point on which the force is exerted and the point at which the force must act. Thus he cites the Hippocratic method of shoulder reposition as requiring more strength than is necessary, because the wrist joint absorbs much of the force intended for the shoulder. He recommends turning the arm so that the humerus just "falls" into place because of its anatomic disposition. According to Pott, the basis of the treatment of luxations, is to bring the luxated portion into such a position that the muscles of the patient himself are able to act on behalf of the operator and restore the anatomic continuity.

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